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(54) Apparatus for monitoring glue application pattern

(57) Apparatus is disclosed for monitoring the application of glue to an object. The apparatus comprises an image-making device 8 for making images of glue 3 applied onto an object 2; a lighting apparatus 12 for lighting the glue at an angle in the range from 20 degrees to 80 degrees with respect to the axis of the image-making device; grey level image producing means for turning images obtained by the image-making device into grey level images; and glue detecting means 11 for detecting, within the grey level images, darker or brighter regions than the peripheral regions. The comparison device produces a gray level distribution curve so as to locate pairs of regions at which the reflected light is lower than a first threshold value indicating a shadow region and higher than a second threshold indicating a leading glue edge reflection.

FIG.1

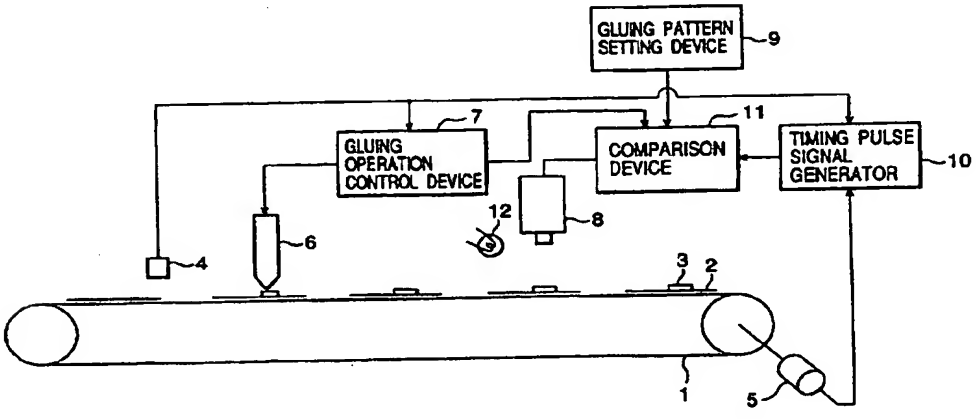

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FIG.1

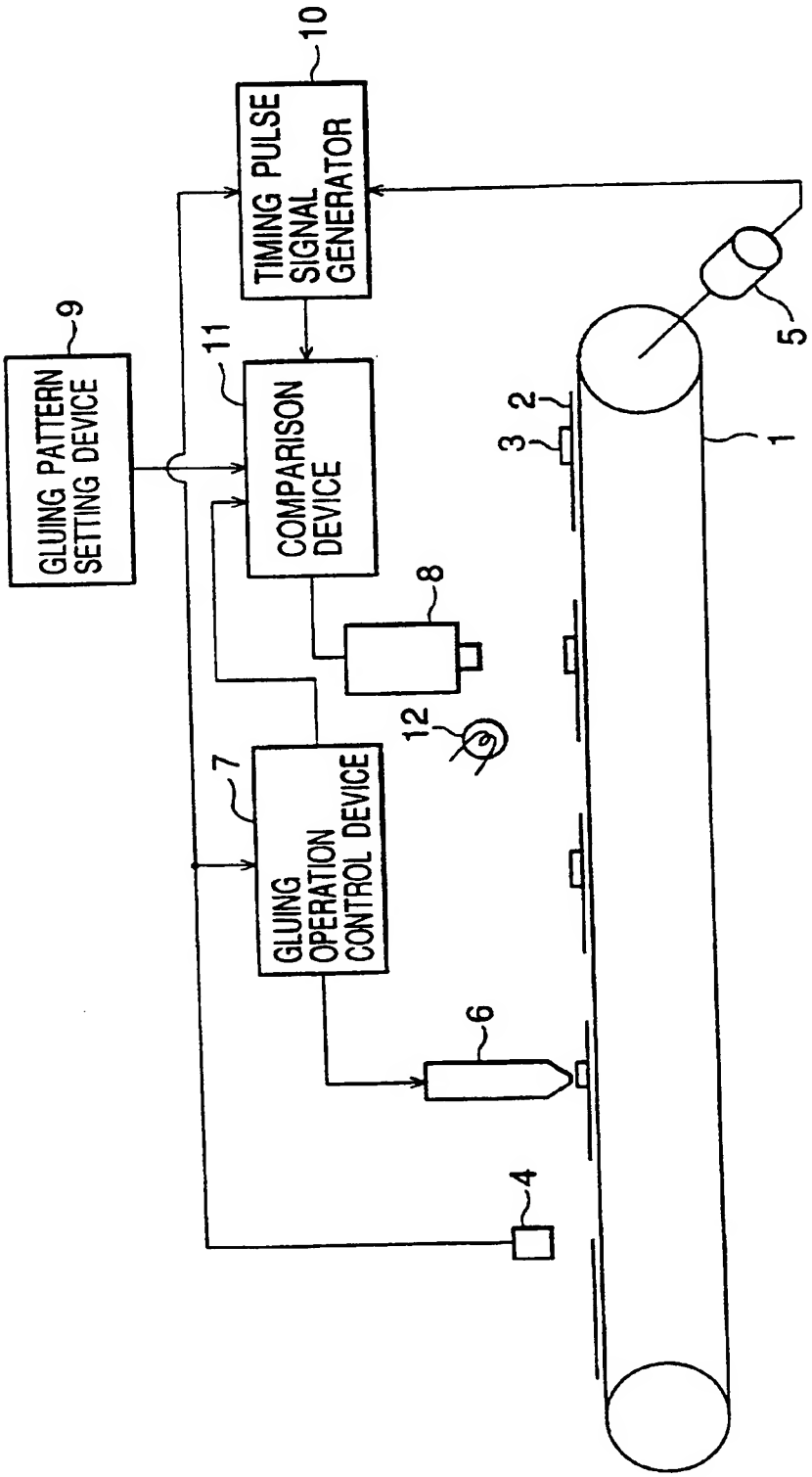

TIMING PULSE SIGNAL GENERATOR
10
GLUING PATTERN SETTING DEVICE
9
COMPARISON DEVICE
11
GLUING OPERATION CONTROL DEVICE
7
8
12
6
4
5
3
2
1

FIG.2

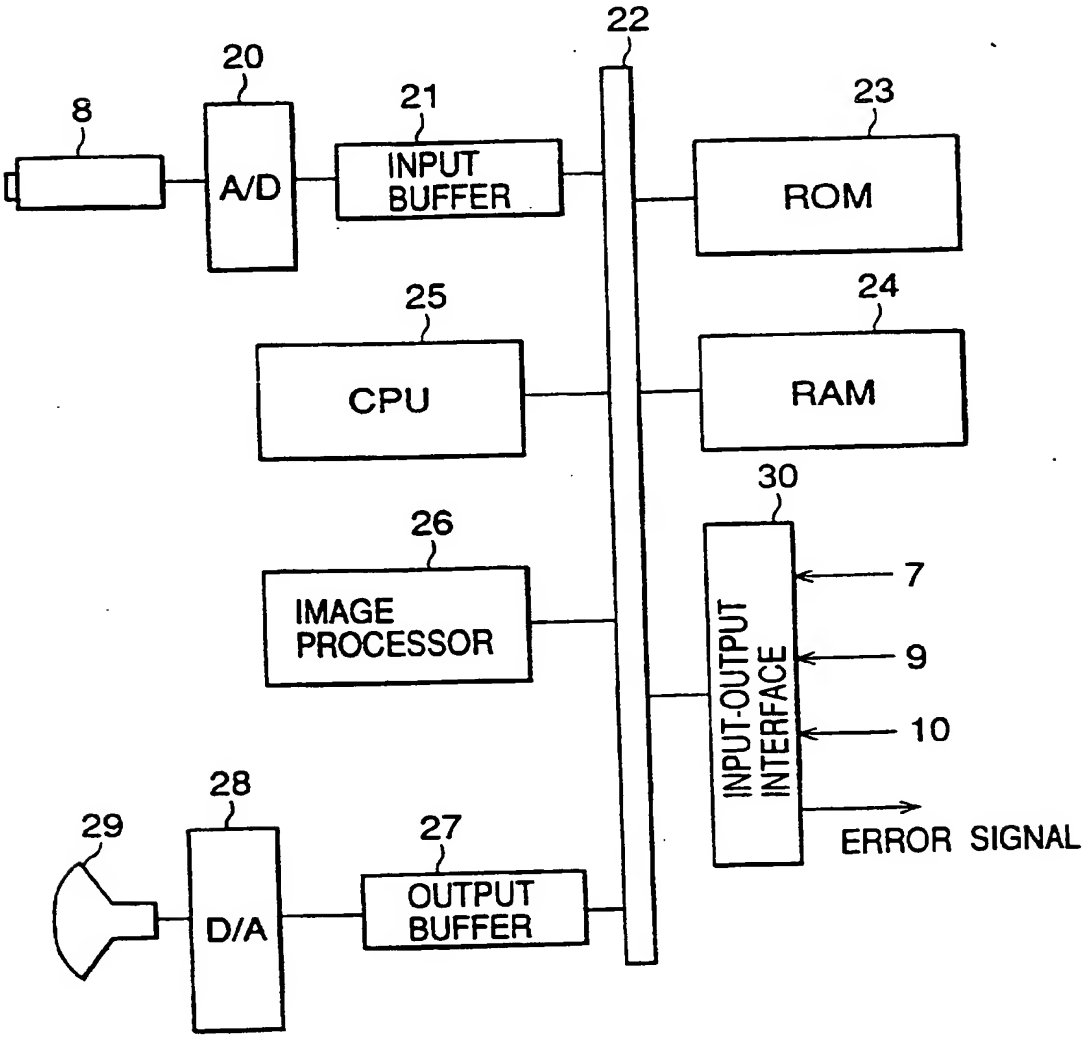

22
20
8
21
23
A/D
INPUT BUFFER
ROM
25
24
CPU
RAM
30
26
7
IMAGE PROCESSOR
9
INPUT-OUTPUT INTERFACE
10
28
29
27
ERROR SIGNAL
D/A
OUTPUT BUFFER

FIG.3A

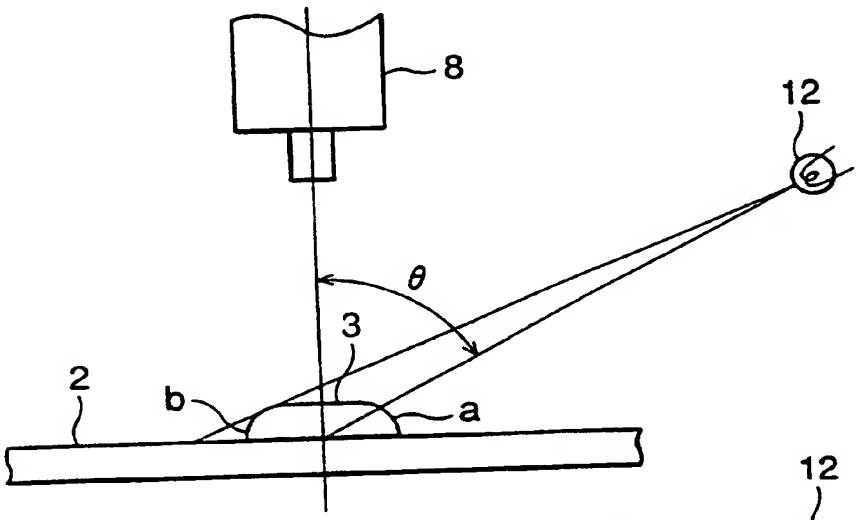


FIG.3B

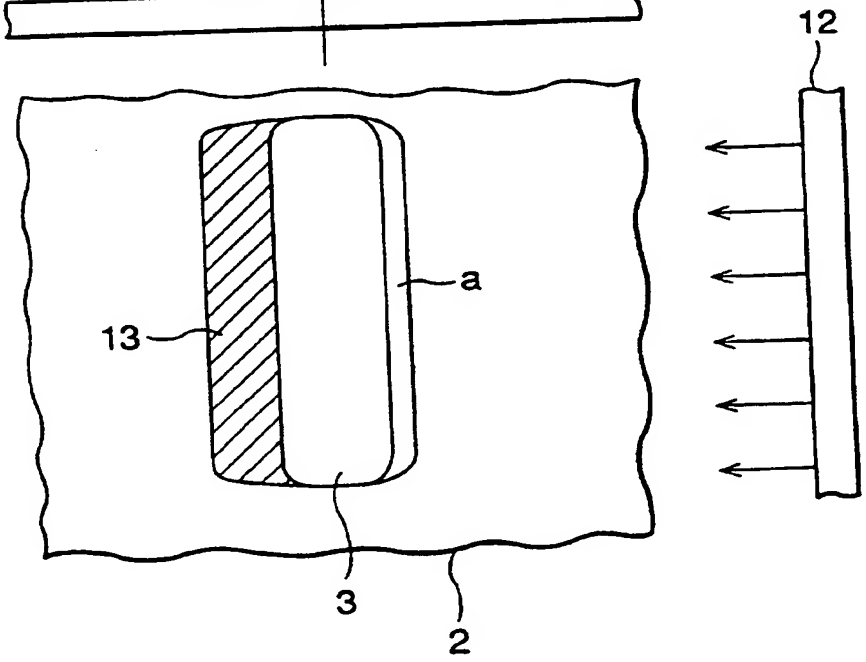


FIG.4A

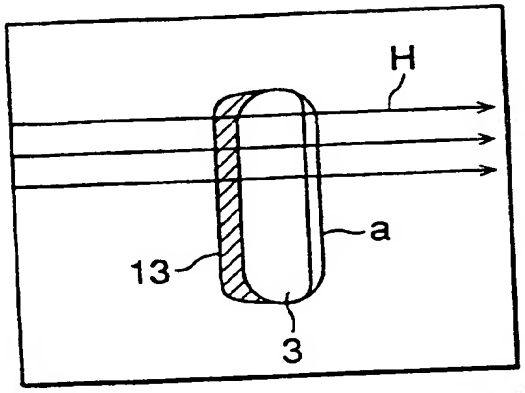


FIG.4B

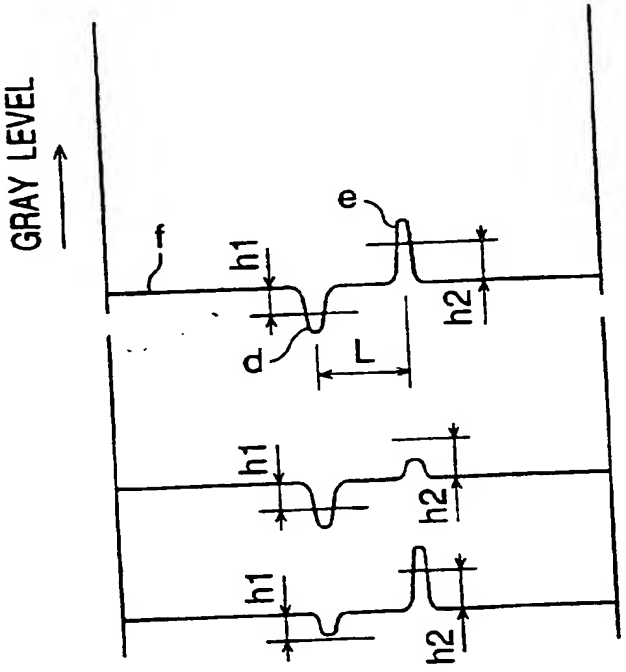


FIG.4C

FIG.5A

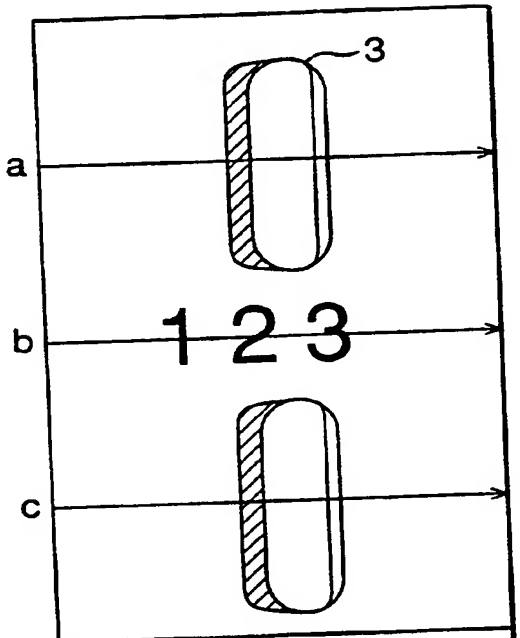


FIG.5B

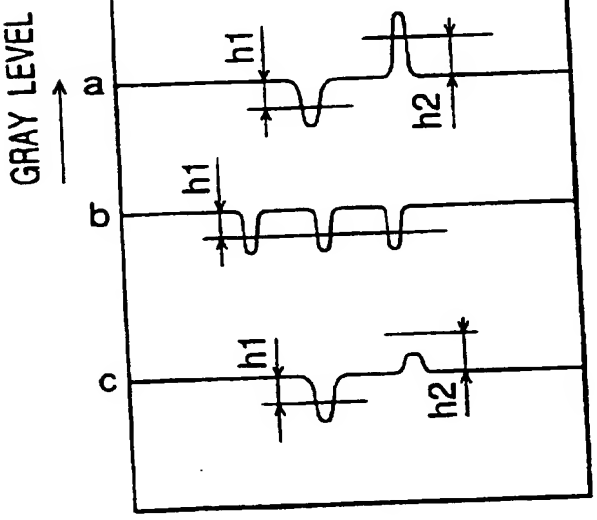


FIG.6A

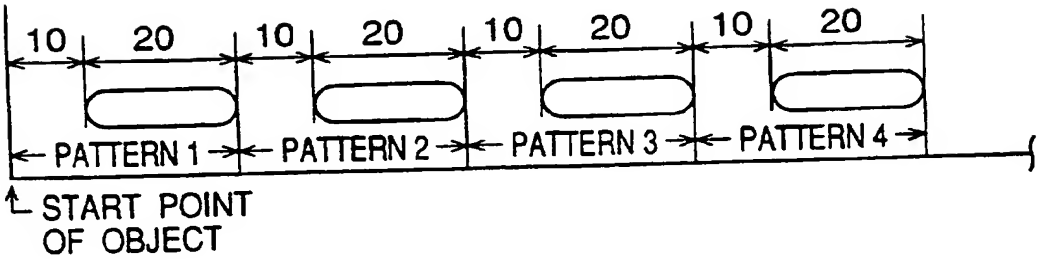

10
20
10
20
10
20
10
20
PATTERN 1
PATTERN 2
PATTERN 3
PATTERN 4
START POINT
OF OBJECT

FIG.6B

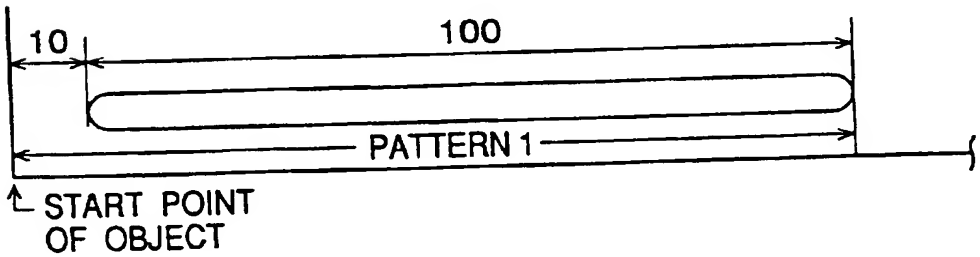

10
100
PATTERN 1
START POINT
OF OBJECT

FIG.7A

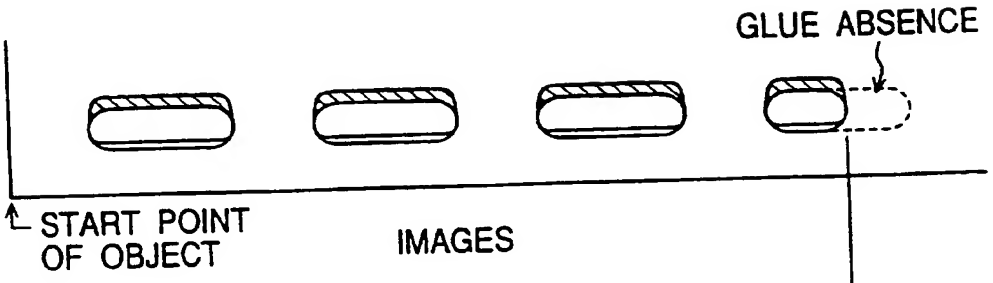


FIG.7B

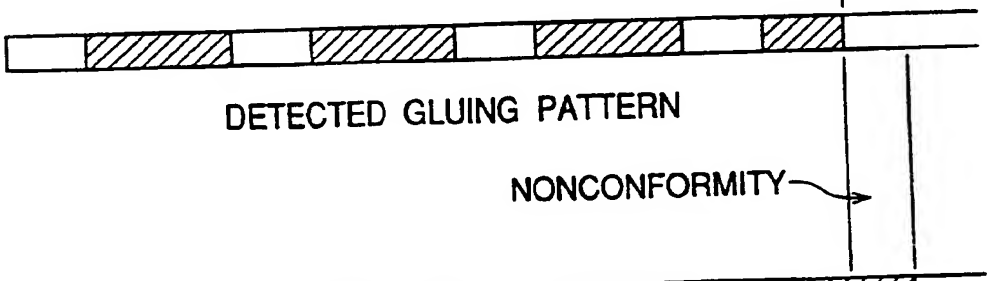


FIG.7C

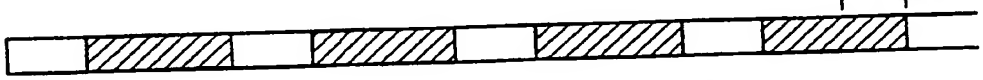
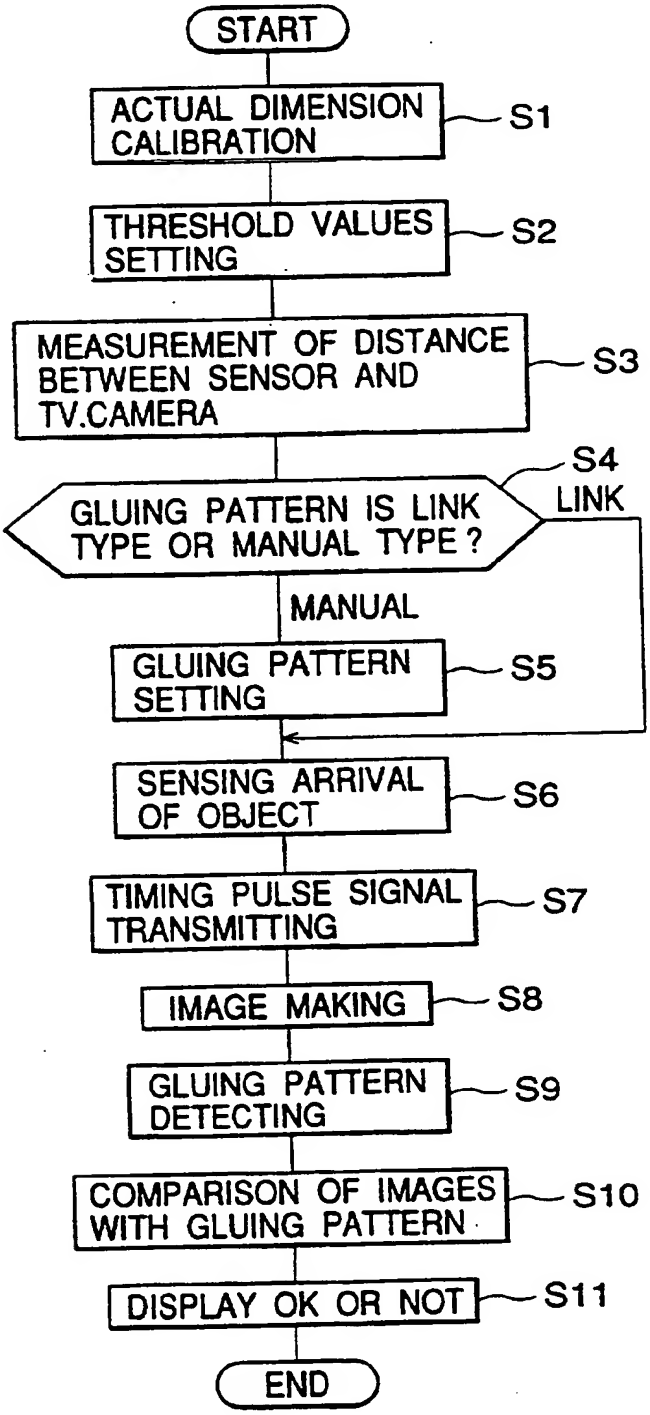


FIG.8


START
ACTUAL DIMENSION CALIBRATION
S1
THRESHOLD VALUES SETTING
S2
MEASUREMENT OF DISTANCE BETWEEN SENSOR AND TV.CAMERA
S3
GLUING PATTERN IS LINK TYPE OR MANUAL TYPE?
S4
LINK
MANUAL
GLUING PATTERN SETTING
S5
SENSING ARRIVAL OF OBJECT
S6
TIMING PULSE SIGNAL TRANSMITTING
S7
IMAGE MAKING
S8
GLUING PATTERN DETECTING
S9
COMPARISON OF IMAGES WITH GLUING PATTERN
S10
DISPLAY OK OR NOT
S11
END

APPARATUS FOR MONITORING GLUE APPLICATION STATE

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

The present invention relates to an apparatus for monitoring glue application state of an object which has been glued by a glue applicator.

PRIOR ART

In gluing processes in sack machines and collators is carried out gluing by means of glue-discharge nozzles. The gluing needs to be tested as to whether the gluing is carried out properly, namely glue is certainly applied to an object through a glue-discharge nozzle.

One of methods of testing whether glue is certainly applied to an object is a method in which two electrodes are disposed interposing a glued object therebetween, and a change in electrostatic capacity between the two electrodes are detected in dependence on presence or absence of glue. Japanese Unexamined Patent Public Disclosure No. 60-99641 has suggested another glue application monitoring method. This method includes the steps of inserting a carton to which glue is applied between a transmitting electrode plate and a receiving electrode plate, transmitting and receiving high-frequency waves between the two electrodes, and monitoring glue application state in accordance with attenuation of high-frequency waves received by the receiving electrode.

These conventional methods using electrostatic capacity or high-frequency waves utilizes a fact that glue contains moisture and thus has electrical conductivity. However, plastic glue has high electrical isolation, and thus the methods such as those using electrostatic capacity and high-frequency waves cannot be applied to such plastic glue. In addition, the conventional methods can test only whether glue is surely applied to an object, and cannot detect which pattern glue has been applied to an object.

One of methods of testing whether glue is certainly applied to an object is an optical method. The optical method includes the steps of lighting glue applied to

an object, photographing the glue through a TV camera, and determining whether glue is certainly applied to an object by using contrast of hues of the glue and the object.

However, according to the method in which contrast of hues is to be used, it is impossible to make the determination if glue has the same hue as that of an object or if glue is transparent in hue. Most of glues are white in color, but similarly most of objects are white in color. Thus, in the above mentioned method, glue has to be colored in a different color from that of an object to which the glue is to be applied. Japanese Unexamined Patent Public Disclosure No. 60-99641 has suggested a glue application monitoring method other than the above mentioned optical method, namely a method using high-frequency waves. This method includes the steps of inserting a carton to which glue is applied between a transmitting electrode plate and a receiving electrode plate, transmitting and receiving high-frequency waves between the two electrodes, and monitoring glue application state in accordance with attenuation of high-frequency waves received by the receiving electrode. However, this high-frequency waves employing method lacks stability because the method is easily affected by the circumferences, and in addition, is not able to evaluate glue application by means of high-frequency waves for plastic glue.

SUMMARY OF THE INVENTION

In view of the foregoing problems, it is an object of the present invention to provide an apparatus for monitoring glue application state by making images of glue application state and comparing the images with a predetermined pattern of gluing to thereby monitor whether the glue is surely applied to an object. It is another object of the present invention to provide such an apparatus which is able to monitor whether glue is surely applied to an object even when an object to which glue is to be applied has the same color as that of the glue.

To solve the above mentioned problems, the invention provides an apparatus for monitoring whether glue is surely applied to an object being

transferred through a transferring machine, the object having been glued upstream of the transferring machine by a glue applicator. The apparatus is characterized by: a sensor for detecting arrival of the object, the sensor being disposed at a predetermined location in the transferring machine; a distance measuring device for measuring a distance by which the transferring machine transfers the object; an image-making device, disposed downstream of the sensor, for making images of the glued object; a timing pulse generator for generating a timing pulse indicating when the glued object passes over the image-making device, in accordance with outputs transmitted from the sensor and the distance measuring device; gluing pattern determining means for determining a pattern with which glue is to be applied to the object; and comparing means for comparing a pattern determined by the gluing pattern determining means with images obtained by the image-making device at a timing indicated by a timing pulse generated by the timing pulse generator, to thereby monitor glue application state.

In a preferred embodiment, the gluing pattern determining means sets a pattern with which the glue applicator glues the object, into the comparing means.

In another preferred embodiment, the apparatus for monitoring whether glue is surely applied to an object is further characterized by a lighting apparatus, disposed in the vicinity of the image-making device, for lighting the object at an angle from an axis of the image-making device, the comparing means monitoring glue application state by means of at least one of images of reflection light reflected from the object and the glue applied to the object and having greater intensity than a predetermined intensity, and of shadow having greater darkness than a predetermined value.

The present invention further provides an apparatus for monitoring whether glue is surely applied to an object, the apparatus being characterized by: an image-making device for making images of glue applied onto an object; a lighting apparatus for lighting the glue at an angle in the range of 20 degrees to 80 degrees with respect to an axis of the image-making device; gray level image producing means for turning images obtained by the image-making device into gray level

images; and glue detecting means for detecting darker or brighter regions than the circumferences within the gray level images.

In a preferred embodiment, the glue detecting means makes a gray level distribution curve from pixel rows which appear on horizontal scanning lines when the gray level images are displayed, with an axis of ordinate indicating gray level and an axis of abscissa indicating locations of pixels, and finds a pixel row in which either a local maximum value greater than a first threshold value or a local minimum value less than a second threshold value appears in the gray level distribution curve, to thereby detect the pixel row appearing on a plurality of adjacent horizontal scanning lines.

In another preferred embodiment, the lighting apparatus lights the glue at an angle in the range of 50 degrees to 70 degrees with respect to an axis of the image-making device.

The present invention further provides an apparatus for monitoring whether glue is surely applied to an object, the apparatus being characterized by: an image-making device for making images of glue applied onto an object; a lighting apparatus for lighting the glue at an angle in the range of 20 degrees to 80 degrees with respect to an axis of the image-making device; gray level image producing means for turning images obtained by the image-making device into gray level images; and glue detecting means for detecting darker or brighter regions than the circumferences, which appear in a pair, within the gray level images.

In a preferred embodiment , the glue detecting means makes a gray level distribution curve from pixel rows which appear on horizontal scanning lines when the gray level images are displayed, with an axis of ordinate indicating gray level and an axis of abscissa indicating locations of pixels, and finds a pixel row in which a local maximum value greater than a first threshold value and a local minimum value less than a second threshold value appear in a pair in the gray level distribution curve with one being spaced from the other by a substantially predetermined interval, to thereby detect the pixel row appearing on a plurality of adjacent horizontal scanning lines.

In another preferred embodiment, the lighting apparatus lights the glue at an angle in the range of 50 degrees to 70 degrees with respect to an axis of the image-making device.

The advantages obtained by the above mentioned present invention will be described hereinbelow.

The timing pulse generating means stores in advance a distance between the sensor and the image-making device, and transmits a timing pulse signal indicating a distance measured by the distance measuring device between the sensor and the image-making device, after the sensor has detected arrival of an object to which glue has already been applied. The comparing means receives images made by the image-making device in accordance with the timing pulse signals, and compares a pattern with which glue has been actually applied to an object with a pattern predetermined by the gluing pattern determining means, to thereby test whether they coincide with each other. Thus, the test is carried out using images of glue application state, and hence independently of the conductivity of glue.

A pattern with which the glue applicator applies glue to an object is used as a gluing pattern, and thus it is no longer necessary to set up a new pattern for use of a test.

When glue has the same color as that of an object or when glue is transparent in color, it is difficult to obtain images of such glue. Glue applied onto an object is raised above a surface of the object in three dimensions. In addition, such glue has a smooth outer surface. Hence, if a front face located closer to the lighting apparatus receives a light at an angle from the lighting apparatus, an intensive reflection light is transmitted from the front face of the glue into the image-making device. On the other hand, over a rear face of the glue and objects onto which glue is to be applied are casted shadow. The reflection light is able to be identified because it has greater intensity than other reflection lights reflected from other portions of the glue and the objects having the same color as that of the glue. In addition, the shadow is also able to be identified because it is darker than other portions of the glue and the objects having the same color as that of the glue. A

region from which intensive reflection light is reflected is spaced away from the shadow by a length approximately equal to a width of the glue, and thus such a region and the shadow can be found in a pair. Thus, it is possible to determine a brighter or darker region than the circumferences or a region in which darker and brighter sections appear in a pair in a gray level image of the glue, as a region onto which glue is applied. In particular, even when letters are printed in the vicinity of the glue, it is also possible to identify the glue independently of the letters by detecting the region in which darker and brighter sections appear in a pair. When the glue is transparent in color, only brighter regions are to be used because the shadow are not casted. The apparatus in accordance with the invention can monitor the glue, of course, when the glue has a different color from that of an object onto which the glue is to be applied.

In a gray level distribution curve of pixels which are located on horizontal scanning lines and which represent gray level images of a portion to which glue is adhered, a shadow having a lower gray level than an average level is represented to be a darker region, whereas a region from which light is intensively reflected is represented to be brighter. By finding these darker regions and brighter regions, it is possible to monitor glue application on an object. Alternatively, since the shadow region is spaced away from the region from which more intensive light is reflected by a length almost equal to a width of glue, it is possible to monitor glue application on an object also by finding a pair of the shadow and brighter region. In monitoring glue application, if data on a single horizontal scanning line is to be used for monitoring, a misjudgment would be made when a dust is adhered to the line. Thus, data on a plurality of adjacent horizontal scanning lines are used for monitoring glue application.

As is obvious from the explanation having been made, the monitoring apparatus in accordance with the invention first makes images of a glued object by means of an image-making device, analyze the images, and compares the images with a predetermined gluing pattern, thereby making it possible to test whether glue is properly applied to the object.

In addition, according to the invention, it is possible to identify glue from an object to which the glue has been applied and which has the same color as that of the glue by lighting the glue so that there are formed an intensive reflection region and shadow, and finding either a brighter region or a darker region of obtained images or a pair of brighter and darker regions. The glue can be monitored even when the glue is transparent in color. In addition, even when the glue has different color from that of the object to which the glue is to be applied, the glue can be detected.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing a structure of the apparatus in accordance with an embodiment of the present invention.

Fig. 2 is a block diagram showing a structure of the comparison device.

Fig. 3A is a font view showing a positional relationship among the image-making device, the lighting apparatus, the glue and the object to which the glue is to be applied.

Fig. 3B is a top view of the lighting apparatus, the glue and the object to which the glue is to be applied.

Fig. 4A is a top view showing the glue applied to an object and gray level images of the glue.

Figs. 4B and 4C show distribution curves of gray level on horizontal scanning lines.

Fig. 5A is a view for explanation of monitoring glue application, distinguishing glue from letters.

Fig. 5B shows distribution curves of gray level on horizontal scanning lines.

Fig. 6A is a plan view illustrating a pattern with which glue is to be applied to an object.

Fig. 6B is a plan view illustrating another pattern with which glue is to be applied to an object.

Fig. 7A is a plan view showing images received in the comparison device.

Fig. 7B is a view showing a detected pattern formed from the images.

Fig. 7C is a view showing a predetermined gluing pattern.

Fig. 8 is a flow chart showing the operation of the embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A preferred embodiment in accordance with the present invention will be explained hereinbelow with reference to drawings.

Fig. 1 is a block diagram illustrating an embodiment in accordance with the invention. A belt conveyer 1 as a transferring machine transfers an object 2 made of paper to which glue is to be applied. The reference numeral 3 indicates glue having been applied to the object 2. A sensor 4 detects arrival of the objects 2 by sensing an end of the objects 2. The sensor 4 comprises, for instance, a photoelectric sensor or a proximity sensor. The reference numeral 5 represents an encoder which reads out rotation of a roller of the belt conveyer 1 and transmits the predetermined number of pulses, for instance, 100 pulses, per a rotation of the roller. Since the number of pulses per a rotation of the roller is in proportion to a perimeter of the roller, the number of pulses represents a distance which is in proportion to a distance by which the belt conveyer 1 has actually moved. Thus, by determining a constant, a distance by which the belt conveyer 1 has moved is able to be calculated on the basis of the number of the pulses. A glue applicator 6 applies a designated pattern of glue to the objects 2. The reference numeral 7 is a gluing operation control device in which a pattern of glue application is in advance stored by an operator. When it is detected through output signals transmitted from the arrival sensor 4 and the encoder 5 that the object 2 arrives directly beneath the glue applicator 6, the gluing operation control device allows the glue applicator 6 to glue the object in accordance with the predetermined pattern of glue.

A television camera 8 monitors the glued objects 2 being transferred by the belt conveyer 1. The reference numeral 9 is a pattern setting device through which an operator determines a pattern of glue for testing. When an operator

inputs a pattern indicating a location and a length of glue to be applied to an object to the pattern setting device 9, such a pattern is stored in a later mentioned comparison device 11. The reference numeral 10 is a timing pulse generator which, after receiving an output signal transmitted from the arrival sensor 4, receives outputs transmitted from the encoder 5 to thereby detect a distance between the sensor 4 and the television camera 8 and also movement of the object 2, and generates a timing pulse signal. In a comparison device 11 is stored a gluing pattern by means of the gluing operation control device 7 or the pattern setting device 9. When the comparison device 11 receives a timing pulse signal transmitted from the timing pulse signal generator 10, the comparison device 11 takes images of the objects thereinto from the television camera 8, and then compares the images with the gluing pattern. If they do not coincide with each other, the comparison device 11 transmits an error signal.

Fig. 2 is a block diagram showing the structure of the comparison device 11. An A/D converter 20 converts analogue data transmitted from the television camera 8 into digital data. A buffer 21 stores the converted digital data therein. Data is transmitted through a bus 22. In ROM 23 is stored a program to be used for operating the comparison device 11. RAM 24 is used as a working area for later mentioned CPU 25 and an image processor 26, and is also used for storing gluing patterns therein. The functions of ROM and RAM explained herein is just an example, and thus ROM and RAM may be replaced with another memory or hardware. The CPU 25 is operated with a program stored in the ROM 23, and controls the all elements constituting the comparison device 11. The image processor 26 carries out image processing of received images such as binary-numbering and shading compensation. The shading compensation is not always necessary to be carried out. An output buffer 27 temporarily stores output data to be supplied to a monitor display 29. A digital-analogue (D/A) converter 28 converts digital data into analogue data, and then transmits the thus digital-analogue converted data to the monitor display 29. The monitor display 29 displays the glue application state photographed by the television camera 8, and the comparison of a

predetermined gluing pattern with an actual gluing pattern shown in the images. An input and output interface 30 receives inputs transmitted from the gluing operation control device 7, the pattern setting device 9 and the timing pulse signal generator 10, and transmits an error signal, thus communicating with external devices.

Figs. 3A and 3B show a positional relationship among the glue, the television camera and the lighting apparatus, Fig. 3A being a front view and Fig. 3B being a top view. Glue 3 applied onto an object 4 has a raised or convex shape in three dimensions. The television camera 8 is disposed along a normal line of the glue 3. The glue 3 and the object 2 are lighted by the lighting apparatus 12 at an angle θ inclining from the normal line. The inclination θ is selected in the range of 20 degrees to 80 degrees, preferably in the range of 50 degrees to 70 degrees. The glue application includes three types: a rounded application in which the glue 3 is applied to the object so that the glue 3 is rounded; a line application in which the glue 3 is applied to the object so that the glue 3 has a certain length in the form of a line; and an intermittent application in which the glue 3 is intermittently applied to the object. The lighting apparatus 12 may be designed to light just a point when the glue 3 is applied under the rounded application, whereas the lighting apparatus 3 is preferably designed to extend along the glue applied under the line application or intermittent application. Fig. 3B shows a shape of the glue 3 when applied under the intermittent application.

A front face a of the glue 3 facing the lighting apparatus 12 reflects light more intensively than other portions of the glue 3 and the object 2 having the same hue as that of the glue 3. On the other hand, there is casted a shadow 13 by the glue 3 at a rear face b of the glue 3 not facing the lighting apparatus 12 and also at the object 2 in the vicinity of the rear face b. The shadow 13 is darker than the other portions of the glue 3 and the object 2 to which the glue 3 has been applied.

Fig. 4A shows gray level images representing the glue and its circumferences, and Figs. 4B and 4C show distribution curves of gray level on horizontal scanning lines H. The images of the glue 3 and its circumferences as

they are located as shown in Figs. 3A and 3B are processed with respect to gray level by the image processor 26 shown in Fig. 2, to thereby obtain gray level images. When the thus processed gray level images are displayed on the monitor display 29, pixel rows on a horizontal scanning line forms a gray level distribution curve as shown in Fig.4B. A dark peak d corresponds to the shadow of Fig. 4A, whereas a bright peak e corresponds to the front face a which reflects a light more intensively. An interval L between the peaks d and e is almost equal to a width of the glue 3. The peaks d and e are detected using threshold levels h1 and h2 each of which is determined to be a certain level upper or lower than an average gray level f of the gray level distribution curve. Specifically, the dark peak d is identified when it extends beyond the threshold level h1, and the bright peak e is identified when it extends beyond the threshold level h2. The threshold levels h1 and h2 are determined in accordance with a thickness of the glue 3. As shown in Fig. 4C, though one of the peaks is short of the threshold level in dependence on the application shape of the glue, it is possible to monitor the glue application state only by the other of the peaks which extends beyond the threshold level.

Thus, it is possible to monitor whether the glue 3 is certainly applied onto the object 2 by detecting the peak level d darker than the threshold level h1 located a certain level lower than an average gray level of the gray level distribution curve, the peak level e brighter than the threshold level h2 located a certain level upper than an average gray level of the curve, or a pair of the peaks d and e spaced away from each other by a length almost equal to a width of the glue 3. Even when the glue 3 is transparent in color, the glue application can be monitored by the bright peak level e. When the object 2 does not have the same color as that of the glue or when the glue 3 is not transparent in color, it is of course possible to monitor the glue application by the apparatus in accordance with the invention. Whether the glue 3 is certainly applied onto the object 2 is judged by a gray level distribution curve of a plurality of adjacent horizontal scanning lines. This is for the peaks not to be affected by noises and so on.

Figs. 5Aand 5B show that a pair of the peak levels enables to monitor glue

application, distinguishing glue from letters. Fig. 5A shows glue applied onto an object, and letters printed on the object, and Fig. 5B shows distribution curves of gray level on horizontal scanning lines. The presence of the glue can surely be detected in the case Fig. 5B-a in which a brighter peak and a darker peak appear beyond threshold levels. In the case Fig. 5B-b showing a gray level distribution curve of the letters printed on the object, only darker peaks can be detected, but brighter peaks do not exist. In the case Fig. 5B-c, brighter peak cannot reach the threshold level, and hence only a dark peak can be detected. In the cases Fig. 5B-b and Fig. 5B-c, the glue is not able to be distinguished from the letters, whereas in the case Fig. 5B-a, a pair of the peaks enables the glue to be distinguished from the letters to thereby make it possible to monitor the glue application.

In Figs. 3A and 3B, when the glue 3 is applied under the line application or intermittent application, a lighting apparatus 12 extending like a line is preferably used. As shown in Fig. 3B, the line of the lighting apparatus 12 is preferably directed to a lengthwise direction of the glue 3. However, even if the lighting apparatus line is at an angle to the lengthwise direction of the glue 3 to some degree, it is possible to monitor the glue application. In Fig. 4A, the lengthwise direction of the glue 3 is perpendicular to the horizontal scanning line H. Even if the lengthwise direction of the glue 3 is at an angle to some degree to the horizontal scanning line H, it is possible to monitor the glue application.

In the above mentioned embodiment, the glue application is monitored when the glue has the same color as that of the object or the glue is transparent in color. However, the invention can also be applied to monitoring the application of material other than glue, such as solder or sticky material discharged through a tube or a nozzle even when solder or sticky material has the same hue as that of an object to which they are applied to, or even when solder or sticky material is transparent in color.

Next will be explained determination of a gluing pattern. A gluing pattern indicates how the glue 3 is applied to the object 2, and has an optionally selected pitch between the glues 3 and an optionally selected length of the glue 3.

The pitch and length are determined in millimeter or inch. Figs. 6A and 6B show patterns of glue to be applied to an object. Fig. 6A shows glue application in which a plurality of glues having a common length is applied to an object with a constant pitch, whereas Fig. 6B shows glue application in which a long pattern of glue is applied to an object. A width of the glue is determined in accordance with an opening diameter of a glue discharge nozzle, and hence the illustrated glue has a constant width.

Glue application shown in Fig. 6A is determined as follows.

Pattern 1: Glue OFF 10 mm
Glue ON 20 mm
Pattern 2: Glue OFF 10 mm
Glue ON 20 mm
Pattern 3: Glue OFF 10 mm
Glue ON 20 mm
Pattern 4: Glue OFF 10 mm
Glue ON 20 mm

Glue application shown in Fig. 6B is determined as follows.

Pattern 1: Glue OFF 10 mm
Glue ON 100 mm

The determination of a gluing pattern can be made either by manually inputing a gluing pattern to the comparison device 11 through the pattern setting device 9 or by inputing a manually determined gluing pattern to the gluing operation control device 7 in link with gluing operation.

Hereinbelow will be explained comparison of obtained images with a determined gluing pattern. Figs. 7A, 7B and 7C show a relationship among obtained images, a pattern formed by the obtained images, and a predetermined gluing pattern. Fig. 7A illustrates images obtained by converting the front face, from which a light is reflected more intensively, and the shadow into be ternary by means of shading compensation of obtained images and further by means of use of appropriate threshold values. Fig. 7B shows a pattern of glue for testing which

indicates a pitch between glues and a length of glue both obtained from ternary images. Fig. 7C shows a predetermined gluing pattern.

In order to detect a pitch between glues and a length of glue from the obtained images shown in Fig. 7A, actual dimension calibration is carried out for knowing how many pixels actual dimension is made from on a display, prior to gluing operation. The actual dimension calibration is performed as follows: a calibration piece having a length sufficient to be displayed within a display without deformation is made to pass over the arrival sensor 4; the timing pulse generator 10 catches outputs which have been transmitted from the encoder 5 when the sensor 4 detects opposite ends of the calibration piece; the outputs are introduced into the comparison device 11; the comparison device 11 calculates a length of the calibration piece; the calibration piece is displayed through the television camera 8; and pixels present on a display are counted. However, the actual dimension calibration is not always necessary to be carried out. Only operation may be carried out for determining a location and a length.

Thus, there is obtained a coefficient for obtaining actual dimension. The number of pixels indicating a pitch between glues and a length of glue are counted in the images shown in Fig. 7A. The thus obtained number of pixels multiplied by the coefficient makes actual dimension of a pitch between glues and a length of glue. By comparing the thus obtained value with a predetermined value, it is possible to test whether glue is applied to an object in accordance with a predetermined gluing pattern.

Each of Figs. 7B and 7C show a gluing pattern at the same scale as that of the images shown in Fig. 7A. Each length in Fig. 7B is represented at the same scale as length in Fig. 7A. For instance, if the glue has a length of 20 mm, the number of pixels to represent the glue within a display is first counted by using the above mentioned coefficient for obtaining actual dimension. Fig. 7C shows the glue with the thus counted pixels. Thus, it is possible to visually compare a predetermined gluing pattern shown in Fig. 7C to an actually detected gluing pattern shown in Fig. 7B. If they do not coincide with each other, how they do not coincide with each

other is also displayed. If such coincidence does not happen, the comparison device 11 generates an error signal.

The entire operation of glue application test in accordance with the embodiment will be explained hereinbelow with reference to Fig. 8 showing a flow chart of glue application test. Steps 1 to 5 represent preparation for carrying out the test, and steps 6 to 11 represent the actual test. First, the actual dimension calibration is carried out in step 1 (S1). As having been mentioned earlier, in the actual dimension calibration, the number of pixels which consist of actual dimension is found out within a display. The actual dimension calibration is carried out by detecting a length of a calibration piece by means of the sensor 4 and the encoder 5, making images of the calibration piece on a display, and obtaining an actual dimension conversion coefficient from the number of pixels present on the display. Then, in order to identify a shape of the obtained images, there are established threshold values for testing whether the brightness of a portion of the glue from which the light is reflected and the darkness of the shadow are within a predetermined value in step 2 (S2). Then, there is determined a distance between the sensor 4 and the television camera 8 so that images of the glued object 2 can be obtained when the glued object 2 comes beneath the television camera 8. Then, it is determined that the setting of a gluing pattern in the comparison device 11 is carried out whether through the gluing operation control device 7 in link with gluing operation or manually through gluing pattern setting device 9 in step 4 (S4). When a gluing pattern is to be set through the pattern setting device 9, a certain value is manually established in step 5 (S5).

The preparation for the test is thus completed, and then the test starts. The arrival sensor 4 detects arrival of the object 2 to which glue is applied and which is made of paper in step 6 (S6). When the paper comes beneath the glue applicator 6, the gluing operation control device 7 allows the glue applicator 6 to glue the paper in accordance with an output signal transmitted from the arrival sensor 4. The glued object 2 is transferred beneath the television camera 8. When the timing pulse generator 10 detects on the basis of an output signal transmitted

from the encoder 5 that the glued object comes beneath the television camera 8, the timing pulse generator 10 transmits a timing pulse signal to the television camera 8 so that the television camera makes the images of the glued object in step 7 (S7). On receiving the timing pulse signal, the comparison device 11 takes the images thereinto from the television camera 8 in step 8 (S8). Then, the comparison device 11 processes the images, namely, detects images of the glue 3 and the shadow by using the already established threshold values, to thereby ternary-processed images as shown in Fig. 7A. Then, the actual dimension of the pitch between the glues is obtained by using an actual dimension conversion coefficient which can be obtained through actual dimension calibration of the images, in step 9 (S9). Then, the thus obtained actual dimension is compared with the already determined gluing pattern in step 10 (S10). Whether they coincide with each other is displayed as shown in Figs. 7B and 7C. If they do not coincide with each other, the comparison device 11 transmits an error signal in step 11 (S11).

In the embodiment, a gluing pattern is represented with one dimensional data such as a pitch between glues and a length of glue. A gluing pattern may be represented with two dimensional data such as a pitch between glues, a length, and a width of glue, to thereby test a width of glue.

CLAIMS:

1. Apparatus for monitoring the application of glue to an object, the apparatus comprising an image-making device for making images of glue applied onto an object; a lighting apparatus for lighting the glue at an angle in the range from 20 degrees to 80 degrees with respect to the axis of the image-making device; gray level image producing means for turning images obtained by the image-making device into gray level images; and glue detecting means for detecting, within the gray level images, darker or brighter regions than the peripheral regions.

2. Apparatus as claimed in claim 1, wherein the glue detecting means is such as to make a gray level distribution curve from pixel rows which appear on horizontal scanning lines when the gray level images are displayed, with the ordinate axis indicating gray level and the abscissa axis indicating locations of pixels, and to find a pixel row in which either a local maximum value greater than a first threshold value or a local minimum value less than a second threshold value appears in the gray level distribution curve, thereby to detect the pixel row appearing on a plurality of adjacent horizontal scanning lines.

3. Apparatus as claimed in claim 1 or claim 2, wherein the lighting apparatus lights the glue at an angle in the range of from 50 degrees to 70 degrees with respect to axis of the image-making device.

4. Apparatus for monitoring the application of glue to an object, the apparatus comprising an image-making device for making images of glue applied onto an object; a lighting apparatus for lighting the glue at an angle in the range of from 20 degrees to 80 degrees with respect to the axis of the image-making device; gray level image producing means for turning images obtained by the image-making device into

gray level images; and glue detecting means for detecting, within the gray level images, darker or brighter regions which appear in a pair, than the peripheral regions.

5. Apparatus as claimed in Claim 4, wherein the glue detecting means is such as to make a gray level distribution curve from pixel rows which appear on horizontal scanning lines when the gray level images are displayed, with the ordinate axis indicating gray level and the abscissa axis indicating locations of pixels, and to find a pixel row in which a local maximum value greater than a first threshold value and a local minimum value less than a second threshold value appear in a pair in the gray level distribution curve with one being spaced from the other by a substantially predetermined interval, thereby to detect the pixel row appearing on a plurality of adjacent horizontal scanning lines.

6. Apparatus as claimed in claim 4 or claim 5, wherein the lighting apparatus lights the glue at an angle in the range of from 50 degrees to 70 degrees with respect to the axis of the image-making device.

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Claims searched: 1-6

Examiner: Andrew Alton
Date of search: 13 May 1996

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Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): G1A: AMAX,AMBP,AMBX,AMZ

Int Cl (Ed.6): G01B: 11/02; G01N: 21/86,21/88,21/89

Other: Online database: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	US 5073951 HAYASHI - See col. 2, line 66 to col. 3, line 39	1,4

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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